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Technical Report ARAEW-TR-08008

RAVEN TANK MAIN ARMAMENT DEMONSTRATOR

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May 2008

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Armaments Engineering & Technology Center
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REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
xx-05-2008	Final	2008

4. TITLE AND SUBTITLE

RAVEN TANK MAIN ARMAMENT DEMONSTRATOR

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

Kathe, Eric ; Miner, Kevin ; Dillon, Robert

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

U.S. Army ARDEC, AETC
Benét Laboratories, AMSRD-AAR-AEW, B. 40
1 Buffington Street
Watervliet Arsenal, NY 12189-4000

8. PERFORMING ORGANIZATION REPORT NUMBER

ARAEW-TR-08008

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U.S. Army ARDEC, AETC
Benét Laboratories, AMSRD-AAR-AEW, B. 40
1 Buffington Street
Watervliet Arsenal, NY 12189-4000

10. SPONSOR/MONITOR'S ACRONYM(S)

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution is unlimited.

13. SUPPLEMENTARY NOTES

14. ABSTRACT

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15. SUBJECT TERMS

Gun Propulsion, Gun Recoil

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			19b. TELEPHONE NUMBER *(Include area code)*
U/U	U	U	U	6	

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RAVEN TANK MAIN ARMAMENT DEMONSTRATOR

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INTRODUCTION

RArefaction waVe guN (RAVEN) propulsion is a widely acclaimed method to impart maximum lethality into a projectile while endowing the launcher with the least recoil momentum and thermal heating. It was originally conceived in 1999 to meet the ambitious lethality and strategic deployability objectives of the future combat systems (FCS) to drive off a C130 transport ready for combat[1]. RAVEN was removed from consideration to meet FCS lethality requirements due to the immaturity of the technology. This paper presents the experimental results of a brass-board tank main armament demonstration system based upon RAVEN propulsion. This technology profoundly alters the system integration options for future main armament.

BACKGROUND

The weapon operates on what is dubbed the rarefaction wave gun principle. In such a gun the breech is intentionally opened while the projectile is still traveling down the barrel. That, of course, causes a dramatic drop in chamber pressure and leads to a rarefaction wave moving up the barrel as pressure rapidly bleeds off through the open breech. The operative principle here is that the speed this rarefaction wave is limited to the speed of sound within the propellant gas. The propulsion of the bullet can only be compromised after the bullet 'hears' the venting.

The implication is that if the bullet leaves the muzzle, as the rarefaction wave reaches it, the muzzle velocity will not be compromised. This concurrence of events is considered to reflect synchronized timing. Venting later will never slow the bullet. Venting earlier will progressively slow the bullet more as recoil is further reduced or eliminated.

Syncronized RAVEN operation expels nominally two thirds of the propellant gas rearward through a rocket nozzle at the breech. This generates substantial forward thrust to mitigate the recoil imparted by the projectile. It also removes hot high-pressure propellant gases from the bore before the bullet has even left the gun. This reduces barrel heating and may profoundly reduce bore erosion relative to traditional closed-breech operation.

RAVEN was first experimentally verified using a bread-board 35mm launcher. Recoil energy was reduced by nearly two thirds with no loss in muzzle velocity due to venting[2]. These tests have provided experimental validation for the development of a one dimensional interior ballistic code for RAVEN[3].

105MM RAVEN DEMONSTRATOR

Following the successful trials in 35mm, a successful large caliber RAVEN was engineered using design and hardware assets remaining from the 105mm Multi-Role Armament and Ammunition System (MRAAS) program[4]. MRAAS incorporated a novel swing chamber and smooth-bore cased telescoped ammunition—with a larger chamber than the fielded 105mm M68 tank gun. This configuration provided 120mm tank gun lethality from an armament system that lent itself to compact combat system integration. The swing chamber approach also affords a straightforward munitions handling method to accommodate RAVEN's rearward facing rocket nozzle. The demonstrator is shown below with the chamber rotated open and mounted to an instrumented hardstand as it is readied for firing.

Table 1: Preliminary Experimental Results.

Projectile Mass	8.311	Kg
Charge Mass	6.289	Kg
Muzzle Velocity	1,156	m/s
Projectile Momentum	9,608	N*s
Measured Momentum	1,695	N*s

To date, four shots have been fired at reduced charge to verify system operation. Full pressure shots are to commence later in May 2008 and are anticipated to be reported at the conference. Preliminary test results from the third shot, fired on 1 May 2008 are listed in Table 1. This test constituted pre-synchronous vent timing. The early venting reduced muzzle velocity and increased momentum reduction relative to synchronous timing.

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[1] E. Kathe and R. Dillon, Sonic Rarefaction Wave Low Recoil Gun, AIAA-01-0743, 39th AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, January 2001.

[2] E. Kathe et al, Experimental Validation of Raven: A New Species of Gun for the Objective Force, JANNAF 38th Combustion Subcommittee Meeting, Destin, Florida, 8-12 April 2002.

[3] Terence Coffee, Modeling of the 35-mm Rarefaction Wave Gun, JANNAF 44th Combustion Subcommittee Meeting, San Diego, CA, December 4-7, 2006.

[4] Leland Ness, Watervliet Arsenal Modifies MRAAS in Order to Support RAVEN Low-Recoil Gun, Jane's International Defence Review, 01 July 2005.